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LBA CONTRIBUTION TO CEOP 2001-2003

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1. Introduction

At the **6th GEWEX Hydrometeorology Panel (GHP) Meeting held 11-15 September 2000, there was a Coordinated Enhanced Observation Period (CEOP) Workshop with broad GHP membership participation.** The CEOP Workshop Summary highlight reports are presented in the following. The planning for CEOP has had one guiding goal—to understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies.

The objective of the simulation and prediction task is to use enhanced observations to document and improve the simulation and prediction of water and energy fluxes and reservoirs over land on diurnal to annual temporal time scales, as well as the prediction of these on temporal scales up to seasonal (for water resource applications). The workshop participants identified what can be done and these were distilled to key items for an implementation strategy. Among the key items for an implementation strategy were the following: (a) Build greater involvement of both the meteorological and hydrological modeling community in CEOP; (b)• Specify what CEOP will provide to GEWEX Panels, WCRP Project Panels and the data we need from these groups; (c) Update global data sets to include CEOP period (including ISLSCP); (d)• Provide high resolution regional model datasets based around monsoon regions as well as other energy sources and sinks to the atmosphere; (e) Provide Model Location Time Series (MOLTS) around regions and areas relevant to CEOP questions; (f) Validate the low-resolution global model output with the "high quality," high-resolution data used in CSE regional models.

The second major CEOP activity identified at the 6th GHP session was to document the seasonal march of the monsoon systems and better understand their physical driving mechanisms and their possible physical connections. Again, from the discussions on what can be done, several key items for the monsoon systems implementation strategy were the following: (a) articulate a few key science issues relevant to the objective; (b) make use of ensemble predictions with "enhanced" initial conditions (IC)/boundary conditions (BC); (c) carry out a series of ensemble seasonal simulations with IC/BC; and (d) conduct empirical (diagnostic) studies.

2. LBA Future plans: Focus in 2001-2003 CEOP

The time span of the CEOP is 2001-2003, and on that period several activities are being planned on the context of LBA, as well as other initiatives linked to CLIVAR/VAMOS and GEWEX with strong associations and highly relevant to LBA. In the following, we will be describing some of the upcoming planned and funded) experiments that will take place in Amazonia as well as measurements and new developments, that are part of LBA. Some of these are related or relevant to LBA. At the end, Fig. 10 and 11 show that the timing of

these experiments in the context of during the CEOP period. As a summary, the following activities are being planned or are being implemented:

Summary of experiments, observational and model development efforts that will take place during CEOP and that LBA and LBA related activities:
See Figs 10 and11 for dates and timing of these experiments and campaigns

FIELD CAMOPAIGNS	CONTINUOS MEASUREMENTS	DATA SYSTEMS AND MODELING
-SALLJ*	-SIVAM**	-LBA-DIS***
-SANTAREM AMC	-INPE-PCD***	-MOLTS-LBA*
- DRY-TO-WET AMC	-FLUX TOWERS***	-PROSUR***
-CLAIRE 2001*	-PIRATA***	-CPTEC MODELS.***
-LARS/TRACE B*	-PACS-SONET***	-USP MODELS***
-ECOLOGY RS *	-INMET (WMO)	-REANALYSES***

* Planning stage (science teams, funding, government approvals, etc.)
** Soon to start (some delay expected in few of these campaigns)
*** Ongoing activities

Field Campaigns and experiments

A) South American Low Level Jet (SALLJ)

This is a major CLIVAR effort highly relevant to LBA. It is a joint effort between universities and research centers of Brazil, Argentina, USA, and Bolivia and Paraguay. This experiment is being planned under the VAMOS initiative.

Justification:
-There are evidences of the occurrence of LLJs cases during the austral warm season that penetrate to subtropical latitudes and are stronger than the more frequent low-level jets more limited to tropical latitudes. (Refer o SALLJ Science Plan, available from M. Douglas, NOAA/NSSL, USA and J. Marengo CPTEC/INPE).
-Occurrence of the LLJs- how important they are in terms of the enhancement of precipitation over eastern and central Argentina, Uruguay and southern Brazil during the warm season, through moisture flux convergence and transport from Amazonia.-These jets and presumably related convection denote a strong diurnal variability with a nocturnal maximum.
-Mesoscale convective complexes (MCCs) display a diurnal cycle with a preferable nocturnal mature phase. A specific issue- nocturnal LLJs and organized convection maxima given the significant contribution of MCSs to the total seasonal precipitation over subtropical South America. *Strategy:*

The overall philosophy of the field program to augment the pre-existing routine observing systems over the region of interest with special observations that will acceptable describe the features of interest. The current radiosonde network over the region will be updated (Fig. 1, 2) essentially all of the stations make only one sounding per day. In addition to supplementing soundings at current stations, it will be necessary to establish temporary radiosonde stations in Bolivia and Paraguay, where no such stations currently exist. The proposed network; the new sites include Cobija, Trinidad, Santa Cruz, Uyuni (Bolivia) and Mariscal Estigarribia (Paraguay). Four of these stations lie along the jet axis, one is on the Bolivian Altiplano, and it may be desirable to operate another at La Paz, Bolivia. Most of the radiosonde stations will utilize GPS navigation to obtain winds. Pilot balloon observations have already been made at each of these sites during the past several years.

Timing and Observations
Planned for October 2002-February 2003, break in December 2002?).
-Radiosonde and pilot balloon observations (up to 8-per day in some sites and during SOP)
-Wind profilers: One of the objectives of ALLS is to describe the diurnal variation of the LLJ. This can be accomplished with the greatest temporal resolution if wind profilers are used. For logistical (at least two 915 MHz profilers will be requested for at least a two month period, one of them in Santa Cruz).
-Aircraft Operations: Possible a NOAA P-3 releasing DWS
-Special rainfall networks (digital high resolution with data logger and pluviometers)

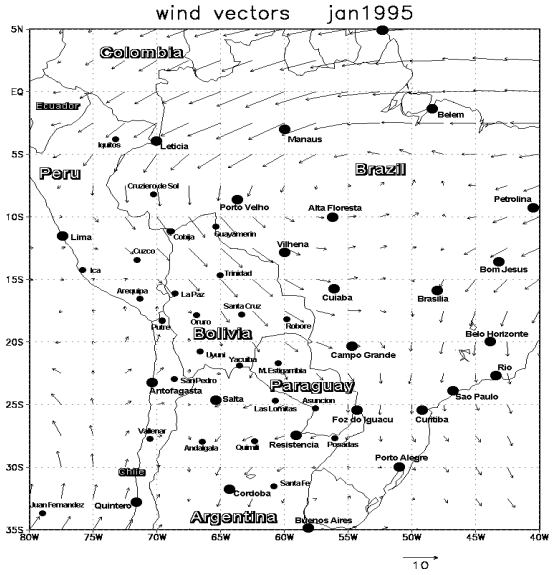


Fig. 1 Large dots are current radiosonde sites, smaller dots are proposed/possible sites.

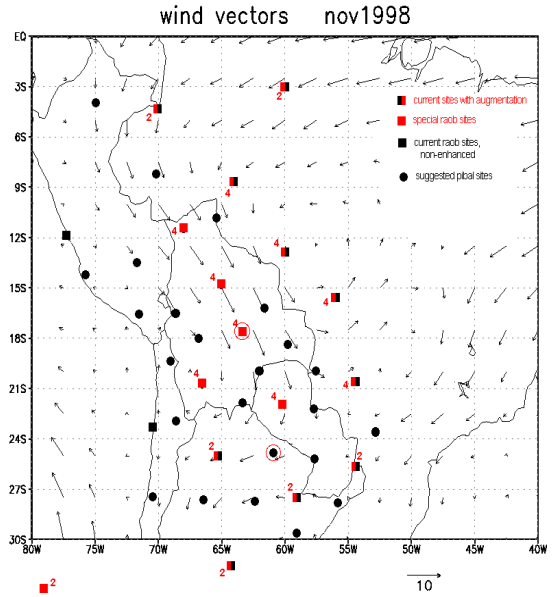


Fig. 2 The black squares are routine radiosonde stations that will not be augmented during the LLJ, the Red and black squares are sites that will be upgraded to either 2 or 4 times (IOP's only) daily, the black circles are pilot balloon sites, and the solid red squares are radiosonde sites that need to be established. Circles suggest locations of two wind profilers (SALLJ Science Plan-Douglas et al. 2000)

Funding:
Argentina (funded)-Argentinean Research Council (M. Nicolini)
USA-Requested from NOAA-PACS, NASA, NSF (to cover also Paraguay and Bolivia) (M. Douglas, J, Paegle)
Brazil-Requested from FAPESP, NASA-LBA HYDROMET (J. Marengo)

B) DRY-TO-WET AMC

It is a field campaign in Rondônia. This campaign will follow the same scheme and objectives of the LBA-WET AMC and TRMM-LBA from summer 1999.

Justification
It will focus on:
-The dry season characteristics,
-Impacts of biomass burning on circulation and rainfall events, and
-The meridional air mass exchange east of the Andes with emphasis in possible LLJ episodes and cold air outbreaks typical of the wintertime dry season.
-Characteristics of circulation, convection before and during the onset of the rainy season in the region. The goal is to investigate dry and moist convective processes over different vegetation cover during he dry season and the onset of the rains in SW Amazonia. (Fig. 3).

Strategy:
Strategy is similar to that of the LBA-WET AMC in Rondônia.

Timing and observations
IOP: July to October 2002 period as part of a dry season and onset of the rainy season atmospheric mesoscale field campaign in Southwest Amazonia (Rondônia). Instrumentation: 4 Radiosonde stations, SODAR, LIDAR Atmospheric chemistry measurements from the flux towers in Ji-Paraná.

FAPESP (?), leader: M. A. Silva Dias (USP).

Fig. 3. Layout of the DRY-TO-WET field campaign in Rondônia (still on discussion). Location of radiosonde in red circles, blue line indicates location of SODAR. Triangle represents the site of the experiment (Source. M. A. Silva Dias)

C) ECOLOGY-RS

Justification
It is planned by NASA-LBA Ecology and is an Amazon wide experiment for remote sensing purposes.

Strategy
This is a remote sensing field campaign using aircraft.

Timing and observations:
It is developed as 4 field campaigns covering the wet and dry seasons during 2002-2003. The field campaigns are planned for April-May and July-August 2003, with a back up date for wet-season work on April-May 2003. Instruments are the AIRSAR and AVIRIS. The former flies on the NASA DC-8. The latter will probably fly on a Twin Otter aircraft. It is possible that there will be other instruments, and still pending the approval of the Brazilian government.

Funding:

Funding is requested from NASA (leader: NASA-LBA Ecology Science team, M. Keller?).

D) SANTAREM AMC

The campaign is focused on mesoscale circulations and cloud formation driven by large river-vegetated surface contrasts, by a campaign of intensive observations on the region

Justification

It is proposed an IOP nearby the Santarém region to characterize the impact of surface heterogeneities in the local circulation and on the clouds formation.

Strategy

Santarém is located between Manaus and Belém, with different types of soil and ecosystems. Few research efforts in LBA are taking place in the region, and the proposed work get support and experiences from these efforts. Fig. 6 shows the proposed measurements and sites. The region is nearby the confluence of the Santarém and Amazon rivers. Use new instruments near by the confluence of these two major rivers in the basin, and also intensive use of observations from flux towers from LBA Ecology (NASA and EUSTACH funded) on the sites.

Timing and observations

It is planned for July 2001. Several upper-air soundings per day (3 to 4) have been proposed at the Santarém airport, SODAR, surface stations and flux towers from LBA-Ecology.Proposed location of pilot balloon is also shown (Fig. 4). Acoustic radar, ceilometer located in Belterra. Radiosonde station located at the Santarém airport. Other projects will operate tethered balloons over forest with sensors for weather and trace gases (blue and yellow triangles). It will be parallel with CLAIRE2001.

Funding:

Requested funding from FAPESP and NASA-LBA HYDROMET (Leader: M. A. Silva Dias)

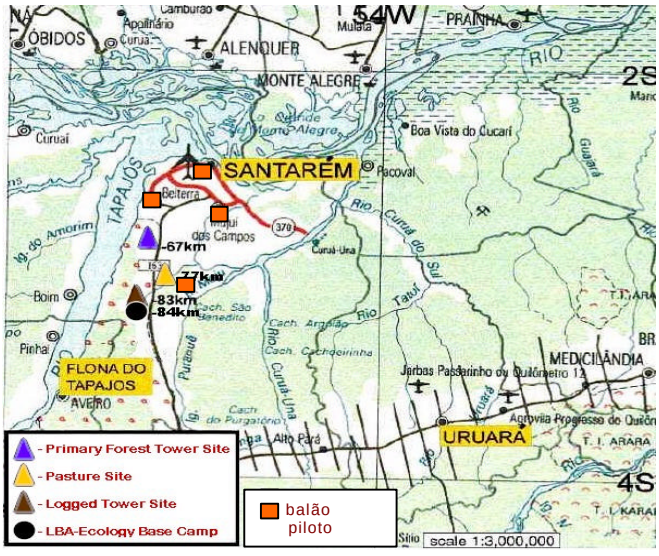


Fig. 4. Location of Santarém nearby the confluence of the Tapajós and Amazonas Rivers. LBA NASA-Ecology sites are indicated. Proposed sites for the location of 2 pilot balloon site are shown. Acoustic radar, cloud observational chamber are located in Belterra. Radiosonde station is proposed nearby the Santarém airport. Sites for operation of trace gases measurements in forest sites is shown in triangles (blue and yellow).

E) LARS/TRACE B

LBA Airborne Regional Source Experiment *and* Transport, Radiation and Chemistry near the Equator- Brazil (LARS/TRACE-B).

Justification
An interdisciplinary aircraft study is proposed to determine the influence of Amazônia on the composition of the global atmosphere. The scientific questions for LARS/TRACE-B are:
-What are the magnitudes of the net sources of radiatively important trace species (CO_2, CH_4, N_2O, CO, O_3, etc.) from Amazônia to the global troposphere?
-What are the magnitudes of the net sources ands sinks of reactive gases and aerosols, and rates for transformations and export of these species to the global troposphere and the lower stratosphere?
-How is human activity (agricultural burning, forest conversion to agriculture) modifying the fluxes of gases and aerosols from Amazônia to the global troposphere and to the stratosphere?
The experiment links closely with ground-based observations and transport models being developed in NASA's Large-scale Biosphere-Atmosphere (LBA) program.

Strategy

Airborne observations are proposed in concert with long-term measurements and model development ongoing in LBA and with space-borne observations. The primary deliverables will be quantitative information on regional-scale net exchanges in Amazônia and neighboring regions, and export fluxes to the global environment for: CO_2 and related gases; Atmospheric chemistry; Biogeochemistry; Application of 4DDA and related model.
LARS/TRACE-B will deploy a potent set of research aircraft with operational capabilities spanning the whole tropical troposphere, from the Planetary Boundary Layer (PBL) to the Upper Troposphere/Lower Stratosphere (UT/LS). The aircraft will be deployed to allow temporal and spatial integration of atmospheric profiles of gases and aerosols. Two deployments are envisioned: one at the transition between wet and dry seasons, focusing on biogenic species, and one in the dry/burning season, examining both biogenic and combustion-derived species. Tracers for combustion (CO, C_2H_2) will be used to distinguish fluxes from biogenic and combustion processes. Biomass density, its change, and carbon-burning rate estimated by remote sensing techniques (including the MODIS instruments) would be closely comparable to the atmospheric fluxes measured by aircraft and satellite.

Timing and observations
It is proposed to take place in a set of campaigns April-May and July-August 2003 and April-May 2004.
Measurements of vertical profiles will be made over the Amazon region for concentrations of target species over both day and night, from the PBL to the tropopause. T

Funding
In planning phase, funds requested from NASA. (Leader: Paulo Artaxo, D. Jacob).

F) CLAIRE2001

This will be a continuation of the LBA-CLAIRE of 1998 that took place in Manaus. The major objectives are to develop a better understanding and to quantify fluxes of anthropogenic gases and chemical processes in the lower atmosphere above the northern Amazon basin.

Justification

LBA/CLAIRE 2001 will help in the understanding the role of atmospheric aerosols in the radiative balance in the atmosphere over Amazonia, since they also affect the biogeochemical cycle of nutrients essential for the Amazon forest. Changes in the land use in the region would affect the concentration of greenhouse gases and aerosols in the atmosphere. CLAIRE2001 will try to understand the exchange of concentration of aerosols between forest and atmosphere above Amazonia.

Strategy

The methodology include the measurements of CO2 fluxes on the boundary layer, fluxes of volatile gases between atmosphere and forest, production of secondary aerosols and its dynamics above the Amazon forest, the impact of anthropogenic emissions in the formation of secondary organic aerosols, quantifications

of the natural primary biogenic aerosol above the forests and its role on the nutrient cycling. The experiment will be based on the Manaus-Santarém area, with intensive use of the INPE-Bandeirante aircraft and the surface observations from the flux towers in Manaus, Santarém and Rondônia.

Timing and observations

The experiment is expected to start in April 2001, and will last 2 years. In May-June there will be a sampling campaign using aircraft. In 2002, field campaigns will be made during the August-November season (dry season). Simultaneously, observations will be made at the LBA sites in Manaus and Santarém, as well as in Rondônia, in coordination with other LBA projects and scientists.

Funding

Funding is requested from FAPESP and the Max Planck Institute. INPE authorized the use of the aircraft (Leader: P. Artaxo)

Continuous Measurements, monitoring and other developments:

A) FLUX TOWER MONITORING

At least 13 flux towers are/will be distributed across the basin (Fig. 5and 6) will remain operational with complementary meteorological, radiative and specific soil moisture measurements collected at each site. Several of these sites are candidates to become CEOP reference sites including validation sites for satellite based remote sensing systems. Some of the sites will have cluster of towers (Santarém-pasture, primary forest logged forest; Brasilia; Ji-Paraná; Manaus; Belém). Together with LBA-NASA Ecology, regional Brazilian funding, and the European contribution to LBA via the EUSTACH program, all of them look for performing flux measurements of CO2, H2O, energy, CH4, N2O, aerosol particles, O3, NOX, and VOC by micrometeorological and enclosure techniques at three representative sites in the Amazon Basin on both, long-term and campaign mode basis integrative and interpretative modeling of the experimental results using a hierarchy of soil-vegetation-atmosphere transfer, ecology, and climate models, as well as atmospheric chemistry/ transport models ranging from micro- to local, regional, hemispheric and global scales.

Fig. 5. Flux tower sites in LBA (all sites)

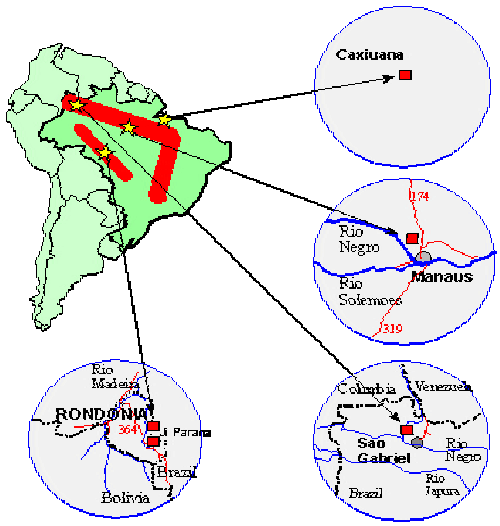


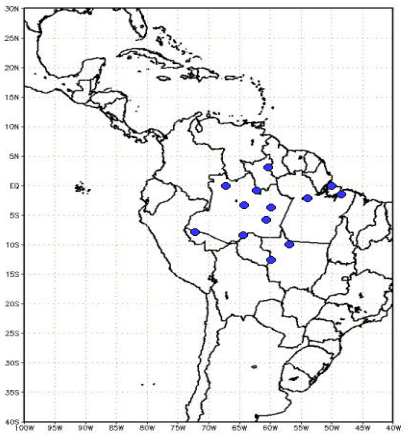
Fig. 6 EUSTACH flux tower sites

These measurements are:
-Climatic variables using automatic weather station
-Surface fluxes of momentum, energy, water vapor and CO2 exchange by eddy-correlation technique
-Profiles of soil moisture and temperature/energy flux
-Soil respiration

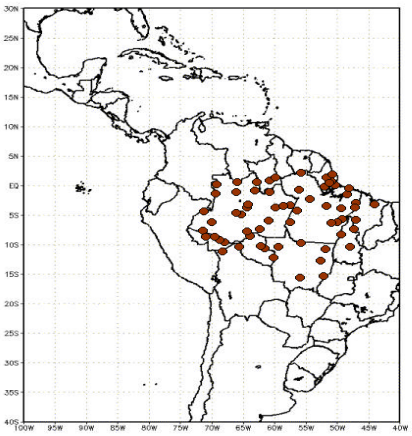
-Complete radiation budget including upward and downward long wave components
-Profiles of temperature, specific humidity, wind speed, CO2 inside the tropical forest
In intensive field campaigns, fluxes of CH4, N20, O3, VOC, aerosol particles, will be made.

B) SIVAM

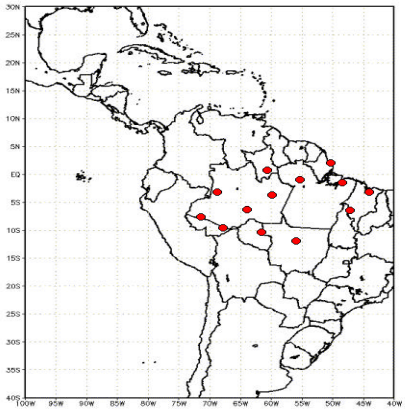
This is the Amazon Surveillance Project (SIVAM), scheduled to start by the end of 2001-beginning of 2002. This Brazilian effort will basically upgrade or update most of the current meteorological (surface and upper-air network) managed by the Brazilian Meteorological Service INMET. It includes new upper-air stations being or to be deployed in the region (13 upper air stations with two soundings a day at 00Z and 12Z), plus several stations of surface, lighting detection, 10 meteorological Doppler radars, an upgrade of the current surface observational network, and approximately 200 automatic hydro-meteorological stations (rain, streamflow, water quality), that will work closely with the INPE's automatic weather and hydrological observation platforms.



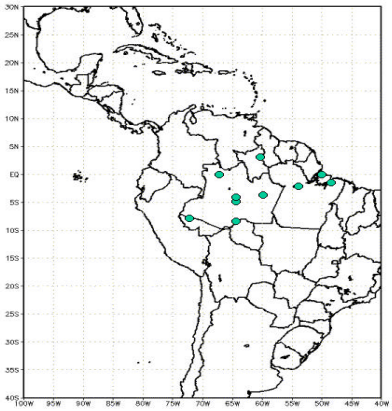
Meteorological radars



Surface stations



Lighting detection stations



Upper-air stations

Fig. 7. SIVAM observational network (Source: SIVAM, CPTEC, CTA)

Current status:
-4 surface stations (Vaisala) and 2 radiosonde stations Digicora of Vaisala (in Jacareacanga and Humaita) implemented, but not in operation yet [Implemented by February 2002, in operation by October 2002]

-Surface and upper-air stations will be in operation and sending information to the central [implemented by June 2002, in operation by October 2002]
-For meteorological radars, EEC (from USA) will provide them [implemented by May 2002, in operation by October 2002]
-For Lighting detectors, ESID of LLP from USA (ELETRONORTE will provide them) [implemented by September 2002, in operation by October 2002?].

C) MOLTS

CEOP will be making critical and comprehensive data available from several global reference sites. Use of these reference sites along with the model location time series (MOLTS) will provide the backbone of the CEOP observations that can be used to validate the satellite data products but also global and regional analyses, simulations, and predictions. Operational models and global reanalysis efforts will be providing MOLTS, which in many cases constitute the only available data for many of the water and energy budget terms. The CEOP Working Group will provide some information of what will be the strategy for MOLTS, such as: "cluster" of MOLTS on some of the LBA reference sites **(e.g. Santarém, Reserva Biologica Jarú in Rondonia),** plus one site in **Santa Cruz-Bolivia** that will be highly relevant to SALLJ. . We proposed additional MOLTS for **Brasilia and FLONA-Caxiuaña** (LBA reference sites) and another in **São Gabriel da Cachoeira**, where the EUSTACH program is working on. Another site that would be relevant to both LBA and SALLJ is the **IPE-Pantanal (Interdisciplinary Pantanal Experiment)**, on the Pantanal region along the Paraguay River and nearby Bolivia ad Paraguay. The coordinates of those sites are sown on Fig. 8, and represent the locations of the MOLTS, as suggested by the CEOP coordination (red stars) and the suggested sites by the LBA science teams.

CEOP Proposed MOLTS locations in South America
1-LBA Rondonia Reference Site: -12.0 -62.0
2-LBA Santarem Reference Site -2.0 -56.0
3-LBA Manaus Reference Site -5.0 -60.0
4-LBA Santa Cruz Reference Site -15.0 -64.0

LBA Proposed new MOLTS locations in South America
5-LBA São Gabriel da Cachoeira Reference Site0.00 29.0 -66.0 -30.0
6-LBA FLONA Caxiuaña Reference Site -01.0 -46.0 -51.0 -27.0 7-LBA Brasilia Reference Site -15.0 -33.0 -47.0 -36.0 8-LBA Pantanal (IPE) Reference Site -19.0 -33.0 -57.0 -00.0

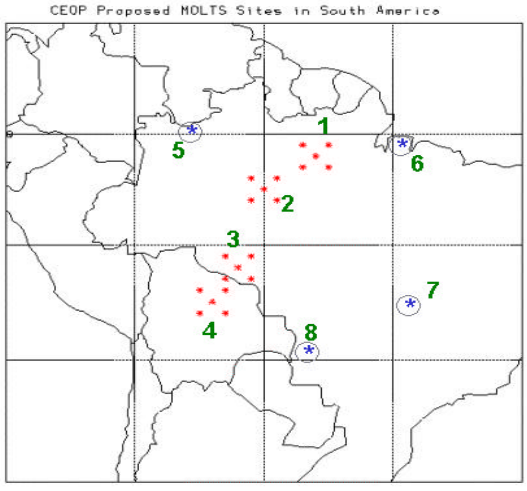


Fig. 8. CEOP Proposed MOLTS for South America (Red stars). Blue stars inside a circle represent suggested additional LBA-CEOP sites.

D) LBA Reference sites

As defined on the CEOP Implementation strategy, Reference sites for CEOP are well instrumented locations of small to intermediate scale areas (10^4 km^2 or less) distributed around the globe in different climatic regimes which can provide the data needed on a mesoscale or smaller for research in land area and

hydrology processes and model validation. The CEOP Reference Sites are expected to cover several orders of magnitude in size as well as being geographically distributed. In the Amazon basin, there are many small watersheds throughout the world that could provide data and research results useful to the scientific objectives for the GHP participants. These small watersheds (some of them being instrumented in Manaus and Rondonia as part of some LBA efforts) would be extremely useful in conducting transferability studies of land surface and hydrologic process sub models. The CEOP Reference Sites provide a first step in making data from small watersheds available for a simultaneous time period and distributed geographically on five different continents. The different types of observations needed from the Reference Sites are listed in Table 2, and some marks are indicated in relevance to LBA-CEOP activities.

Table 2. Reference Site Observation Types in each Layer (CEOP Implementation Plan and "adjusted to LBA")

1. Atmosphere Z < Tropopause: [being or to be made as part of some of the mesoscale field campaigns and continuous measurements in Amazonia: SALLJ; SANTAREM-AMC; DRY-TO-WET AMC; CLAIRE2001, SIVAM, PACS-SONET]

- 1.1 Temperature profiles
- 1.2 Water vapor profiles
- 1.3 Wind profiles
- 1.4 Clouds

2. Surface (0 < Z <10 meters): [already made at the LBA experimental site's flux towers]

- 2.1 Temperatures, Specific Humidity, Wind Component, and Surface Pressure
  - U & V component wind speed at 10 m
  - Temperature and Specific humidity at 2 m
  - Surface pressure
- 2.2 Surface momentum flux
  - Surface U and V wind stress
- 2.3 Surface sensible and latent heat fluxes and Soil heat flux to Surface
- 2.4 Surface skin temperature
- 2.5 Precipitation (including snow)
- 2.6 Surface Radiation
  - Downward short-wave and Upward short-wave (albedo)
  - Downward and upward long wave
  - Net radiation (measured)
  - Photosynthetically Active Radiation (PAR)
- 2.7 Surface and ground water
- 2.8 Vegetation type and characteristics
- 2.9 Site description

3. Sub-surface (-2 < Z < 0 meters) [already made at the LBA experimental site's flux towers]

- 3.1 Soil moisture (profiles)
- 3.2 Soil temperature (profiles)
- 3.3 Soil physical and hydraulic properties
- 3.4 Soil water retention data, Soil texture, Particle size and Bulk density
- 3.5 Organic carbon and matter
- 3.6 Parameters for estimation of soils retention properties

Measurements made at LBA experimental sites that can be of relevance to CEOP's list of variables for proposed reference sites (Table 3): flux of CO2, H2O, energy, CH4, N2O, aerosol particles, O3, NOX, and VOC by micrometeorological and enclosure techniques at three representative sites in the Amazon Basin on both, long-term and campaign mode basis integrative and interpretative *modeling* of the experimental results using a hierarchy of soil-vegetation-atmosphere transfer, ecology, and climate models, as well as atmospheric chemistry/ transport models ranging from micro- to local, regional, hemispheric and global scales. Similar measurements are being made at Santarem, Reserva Biologica Jaru (Rondônia), Manaus and Caxiuaña forest sites.

Table 3. LBA measurements at Rondônia Sites. – Brazilian-European Tower Consortium (Similar measurements are taken at Santarém, Manaus and Caxiuaña, with differences for forest and pasture sites), and Pantanal region/

Forest site – Rebio Jaru (10° 4.706' S; 61° 56.027' W; 190 m above sea level) (Fig. 9a)
)
Half hourly measurements (started in March 24 th)
Sensors at instrument tower
Air temperature profile (6 levels)
H2O and CO2 concentration profile (6 levels)
Top canopy temperature (Infra-red sensor)
Wind velocity profile (4 levels)
Wind direction
Air pressure
Precipitation
Incoming and outgoing solar radiation (short wave radiation)
Incoming and outgoing terrestrial radiation (long wave radiation)
Incoming photosynthetically active radiation (PAR)
Turbulence measurements above forest canopy
High frequency (10.4 Hz) three wind components, air temperature, H2O and CO2 concentration (Sensible and latent heat flux and CO2 flux)
Soil measurements
Soil heat flux (2 plates at depth of 1 cm and 10 cm, respectively)
2 five-level profiles of soil humidity, electric conductivity and temperature (sensors at depths of 5, 15, 30, 60 and 100 cm)

10 minutes measurements
Spatial distribution of soil humidity (11 sensors)
Additional soil temperature and humidity profile (4 levels)
Additional surface soil heat fluxes (2 sensors)

Weekly measurements
Neutron probe soil humidity (8 profiles)

Monthly measurements
CO2 soil respiration

Pasture site – Faz. Nossa Senhora (10° 45' S; 62° 22' W; 220 m above sea level)(Fig. 9b)

Half- hourly measurements (started in Feb 5 th)
Sensors at instrument tower
Air temperature and relative humidity
Surface temperature (Infrared sensor)
Wind velocity and wind direction
Air pressure
Precipitation
Incoming and outgoing solar radiation (short wave radiation)
Incoming and outgoing terrestrial radiation (long wave radiation)
Incoming photosynthetically active radiation (PAR)
Turbulence measurements
High frequency (10.4Hz) three wind components, air temperature, H2O and CO2 concentration (Sensible and latent heat flux and CO2 flux)
Soil measurements
Soil temperature (4 sensors at depth of 1 cm and 4 at 10 cm)
Soil heat flux (4 plates at depth of 1 cm and 4 at 5 cm)
2 five-level profiles of soil humidity, electric conductivity and temperature (sensors at depths of 1, 5, 10, 40 and 100 cm)

10 minutes measurements
Spatial distribution of soil humidity (29 sensors)
2 additional soil temperature and humidity profiles (4 levels)
Additional surface soil heat fluxes (3 sensors)

Weekly measurements

Neutron probe soil humidity (6 profiles)
Soil water level

Monthly measurements
CO2 soil respiration
Grass biomass and leaf area index

Fig. 9a: Rebio Jaru Flux tower 9b Fazenda Nossa Senhora Flux tower

Pantanal site-Fazenda São Bento (19 ^{o} 33'S, 57 ^{o} 54'W)

Meteorological campaign in the Pantanal area in south-central Brazil during wet and dry seasons to study boundary layer process and influences on weather and climate in the region (Planned campaign for wet season of 2002)
-Sensors at instrument tower (21 meters high)Air temperature profile (5 levels)
H2O concentration profile (5 levels)
op canopy temperature (Infra-red sensor)
Wind velocity profile 5 levels)
Wind direction
Air pressure
Precipitation
Incoming and outgoing solar radiation (short wave radiation)
Incoming and outgoing terrestrial radiation (long wave radiation)
Incoming photosynthetically active radiation (PAR)
Turbulence measurements above forest canopy
High frequency (10.4 Hz) three wind components, air temperature, H2O and CO2 Concentration (Sensible and latent heat flux and CO2 flux)
Soil measurements
Soil heat flux (2 plates at depth of 1 cm and 10 cm, respectively)
2 five-level profiles of soil humidity, electric conductivity and temperature (Sensors at depths of 1, 5, 10, 20, and 40 cm)
Methane concentration
-Additional instrumentation:
Radiosonde stationTethered balloon

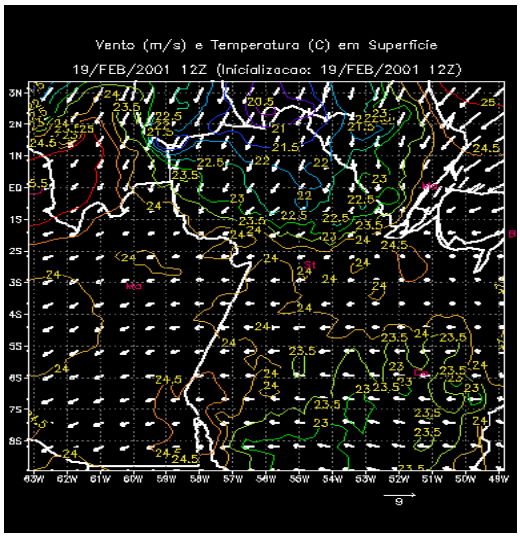
E) MODEL DEVELOPMENT

At CPTEC: Regarding model development and related activities, improved atmospheric models will be available during CEOP including those to be developed and run on a new more powerful computer system being installed at CPTEC/INPE in 2001 (NEC SX-5).
The suite of models that will be available during CEOP will include the CPTEC Global model at resolution ~70 km, 40 vertical levels, the Eta regional model with SSiB coupled over South America with resolution of 20 km and 50 vertical levels.
Reanalysis of Eta model (with bucket and SSiB) during LBA periods, using regional PSAS and high resolution (20 km, 50 levels).

-Ongoing validation of results using Eta/bucket for the LBA WET AMC December 1998-March 1999.

-Planned runs of reanalysis using LBA CEOP 2001-2003 information with Eta/SSib.Analysis of the NCEP and ECMWF operational models will also be collected. Special efforts to collect satellite data over the LBA area will be underway during CEOP including from the existing suite of operational meteorological satellites, new research satellites (i.e., TRMM, TERRA, EOS PM1, etc.) and special earth resources satellites such as LANDSAT 7, and the Brazilian-Chinese satellite and possibly others. In addition, products such as the LBA-HYDROnet are to be incorporated in helping the depiction at high-resolution water balance/river routing in the Amazon basin.

At USP: Operational 48 hour forecast over the eastern Amazon is produced at USP. The forecast is produced with the Regional Atmospheric Modeling System - RAMS version 4.3 and is based on the 12 UTC analyses available from CPTEC. The current operational cycle is based on a system of 3 nested grids (112, 28 and 7 km). The coarsest a grid is used to assimilate the CPTEC analysis and forecast at the border of the RAMS domain. The 28 km grid covers most of the eastern Amazon including the coastal area near Belém. The 7 km grid covers an area 280 X 280 km centered at Santarém. The objective of the 7 km grid is to capture the basic effects of the Tapajós and Amazon River breeze. The 28 km grid is able to crudely reproduce the squall lines, which form along the coast and propagate inland.Considerable tuning of the model physics has been done in order to improve the forecast skill in the eastern Amazon (surface processes, radiation). A complete atmospheric data assimilation cycle is under testing in the eastern Amazon, with emphasis on the use of the available surface data. Plans underway to run the CO and other trace gases assimilation cycle during the next burning season. Figs 11a and b show some of these products for eastern Amazonia and South America.



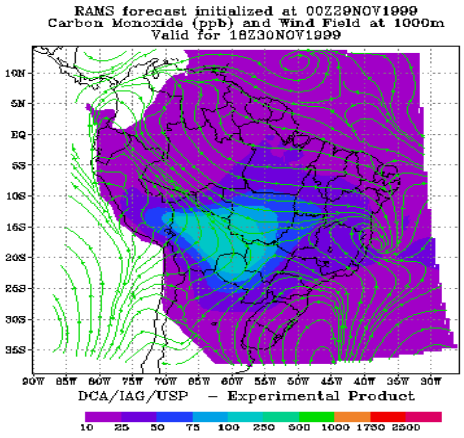


Fig 11:a) RAMS surface wind and temperature forecast in Eastern Amazonia. b) RAMS CO and wind fields at 1000 m for South America.

F) LBA-DIS

An LBA-wide, web-based Data and Information System (LBA-DIS) have been established. It is operational and provides a number of user-friendly tools for submission, documentation, search and retrieval of data and information – see www.cptec.inpe.br/lba. The metadatabase population of LBA-DIS has improved drastically since the time of the First Science Conference of LBA. As of February 06,2001, more than 208 entries are searchable. These entries represent research products from Brazilian, American and European researchers. The actual data submission still needs to be improved.

It is clear that LBA-DIS will be ready to assimilate and archive the data generated during the field campaigns that will happen during the CEOP life time 2001-2003, either observational data, including satellite data, field observations from aircrafts and flux towers, surface and upper-air observations, model output and other type of information. The data policy and copyright issues are being discussed

on individual basis. NASA and NOAA have an open policy on data, and the Brazilian agencies have policies that indicate free access to Brazilian scientists. The data resides either in CPTEC or it is distributed in several centers or universities, and it is possible to look for them by accessing the Beija Flor system from the LBA-DIS.

Beija Flor is a Web-based metadata search and data retrieval system designed for tracking scientific metadata. It is a standards-based system, a "virtual system" with data and metadata distributed over the Internet under the control of investigators, and it also provides rapid (nightly) updates (Fig. 11). Other users of the Beija Flor system are the ORNL DAAC, EOS Land Validation, Safari 2000, and NASA Earth Science Info. Partners

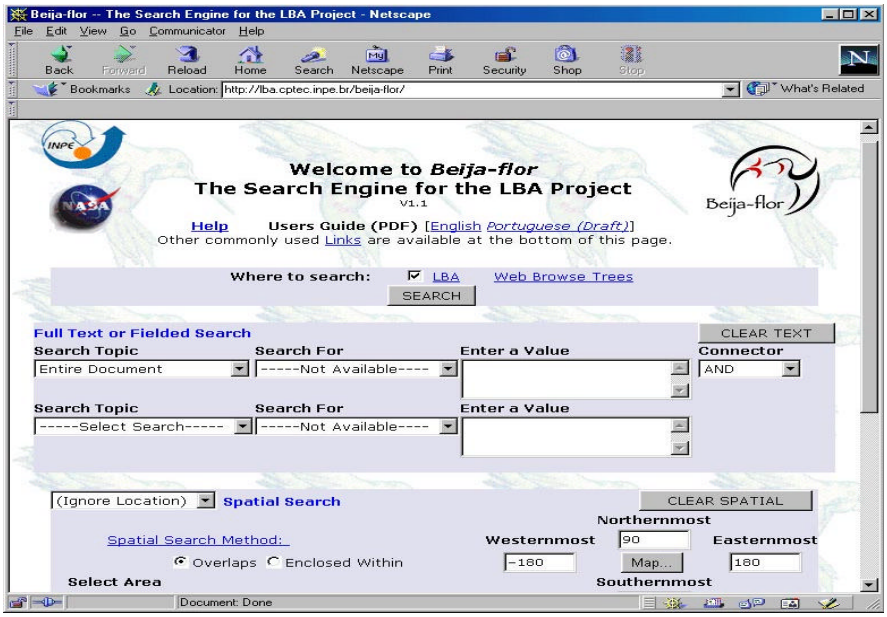


Fig. 11: LBA-DIS Beija Flor search engine system for LBA. (Source: L. Horta)

Timetable of LBA and LBA-related activities during the CEOP period

Fig. 12 shows the timetable 1998-2010 of several activities (fields experiments and measurements) planned or in execution. The gray box shows the CEOP time frame. Activities such as SIVAM and Flux tower measurements are planned as long-term activities, together with INPE and INMET continuous monitoring (automatic weather and hydrological observations, surface and upper-air observations), as well as the PACS-SONET upper-air sounding network (not shown on the figure). The LBA-DIS is already in operation, and will be able to handle and archive data or direct requests for data to the scientists involved on the different experiments. Fig. 13 is a "zoom" of LBA activities only during 1999-2004, with the CEOP period in 2002-2003.

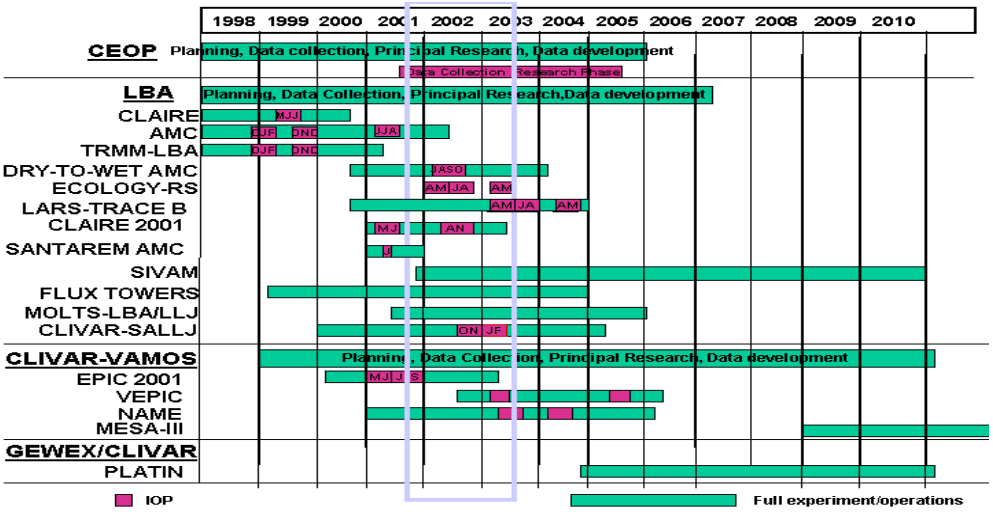


Fig. 12: Past and proposed timeline of LBA and LBA-related planned activities. Other efforts relevant to LBA, such as those developed as part of CLIVAR, IAI and GEWEX are also included. Green boxes represent the time period from planning to data development, while purple boxes indicate the approximate timing of field experiments and campaigns (Source. J. A. Marengo)

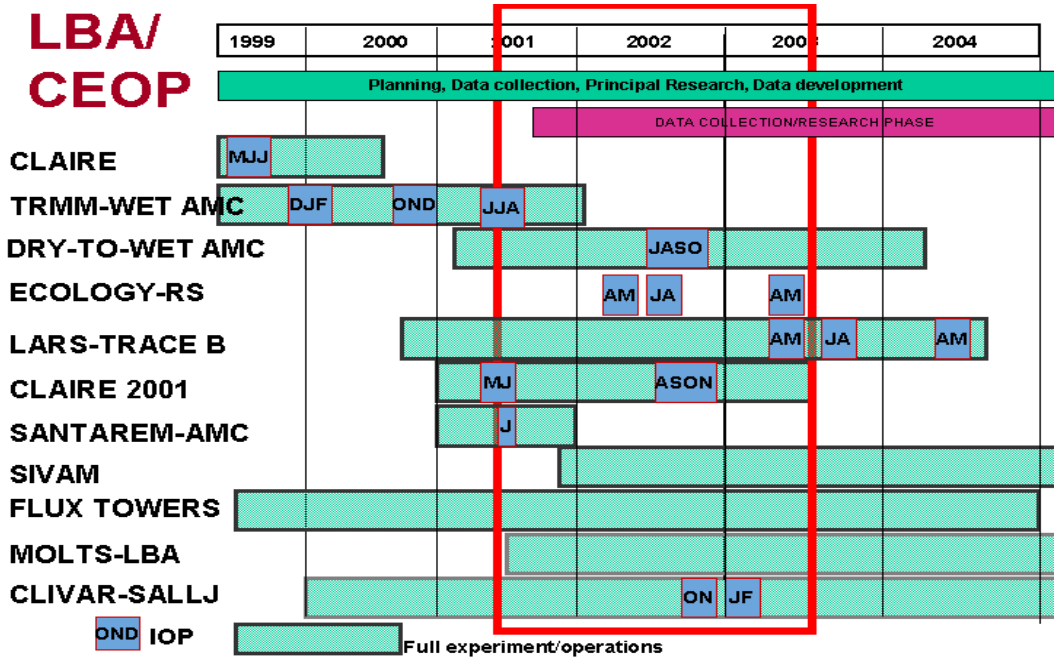


Fig. 13: Proposed timeline of LBA and LBA-related planned activities in relation to CEOP] Indicated by red box) (Source: J. A. Marengo)